This presentation is a 2013 snapshot of local water quality issues and testing done in the Moultonborough Bay Inlet Sub-watershed by Moultonborough as part of the UNH Lay Lakes project. Please bring any questions, errors, omissions or concerns to any member of the Moultonborough Conservation Commission.

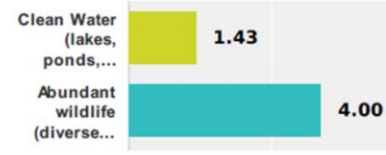
It is an update to a presentation at a planning board meeting in Moultonborough, NH on January 22, 2014.

If your organization would benefit from a member of the Conservation Commission giving this presentation and taking questions, please submit your request through the town offices, at 603-476-2347.

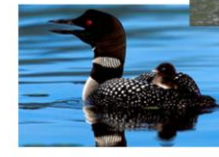
Why is Water Quality an Issue

- Top issue in town survey
- Recreation value drives economic viability of town and region
- Impacts dominant species of fish, plant and wildlife
- NH mountains and forests store rich nutrients, stripped by runoff
- Human activity accelerates lake aging
- We haven't broken the lake – yet – but have a significant impact

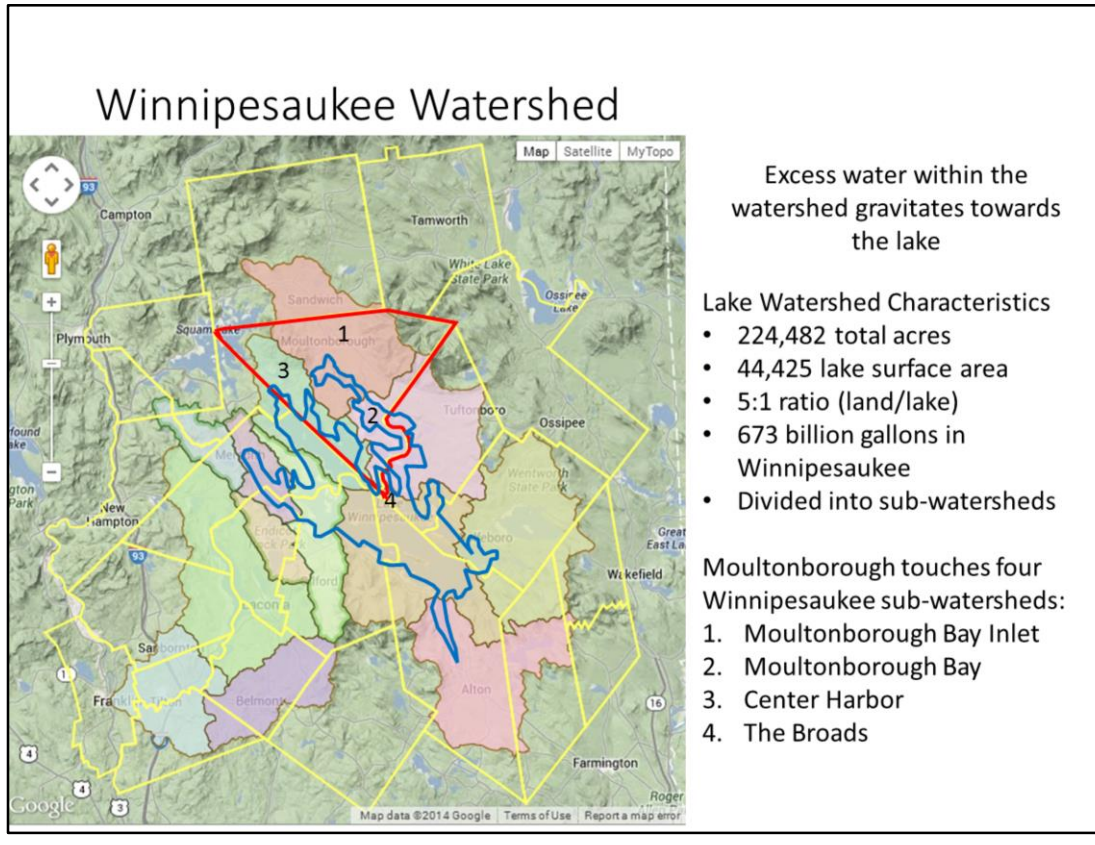
How should we manage the watershed for current and future generations?



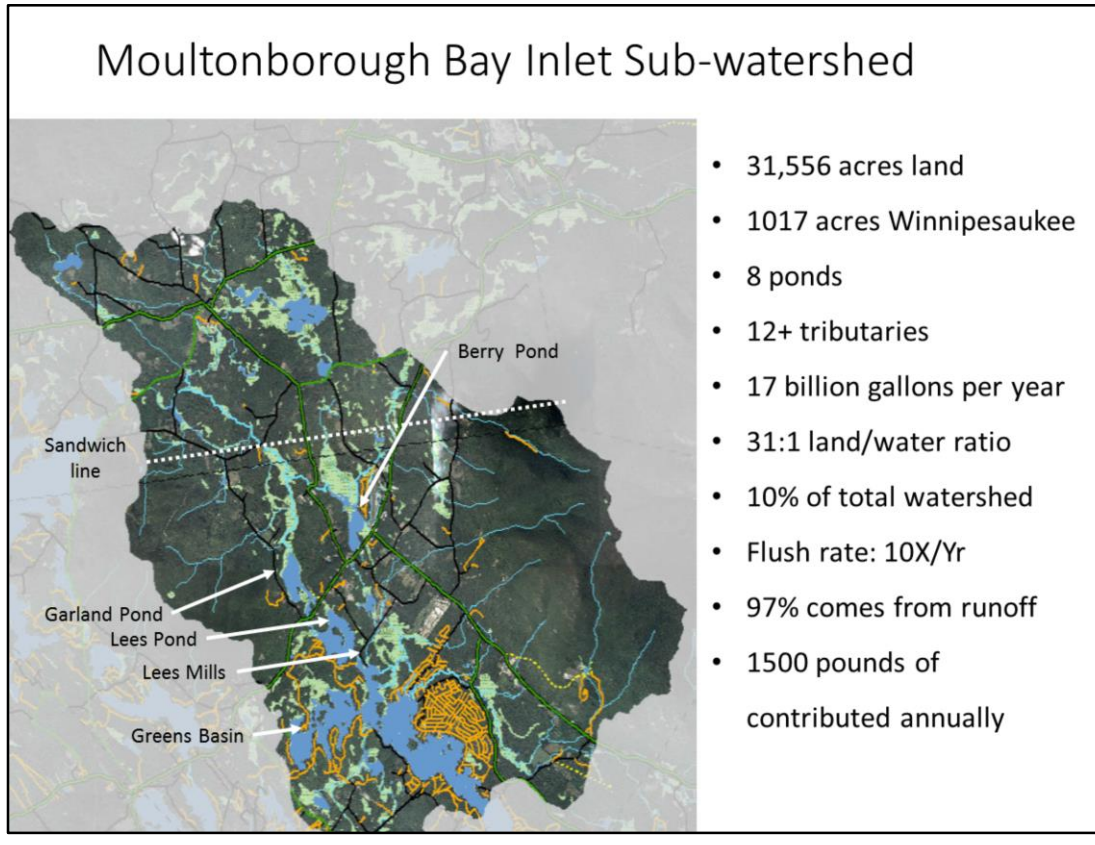
Source: 2013 Master Plan Survey



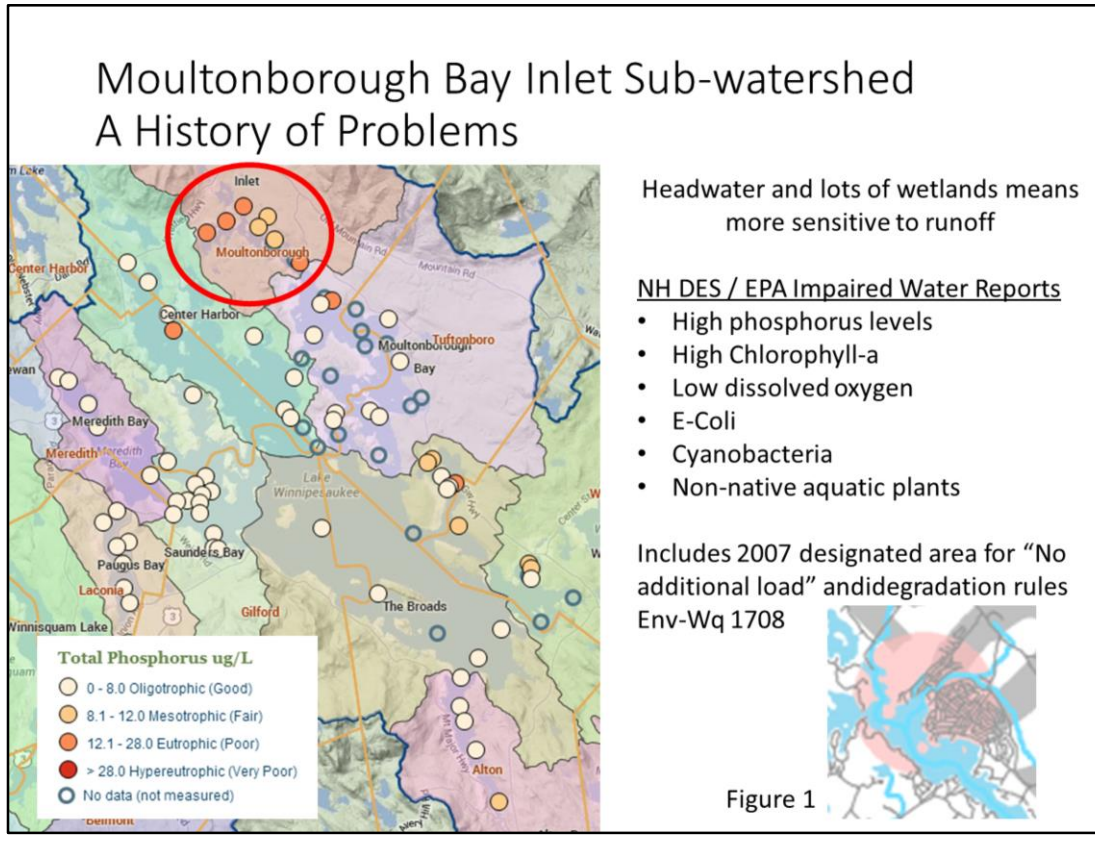
Most people agree that clean water is important. In a 2013 Master Plan survey, town residents picked clean water as the number one resource in town by a large margin. We recognize that water quality drives the economic engine of the town and the entire lakes region. If the desire to swim, fish, vacation or live by the lake reduced, so would jobs and the property tax base. Another issue of water quality, is the dominant species fish, wildlife and plants. We find more milfoil and fewer salmon in areas with lower quality water. Here in central NH, we enjoy mountains and dense forests, rich with nutrients. Unfortunately, human activity, such as trails, roads, homes, golf courses, farms and motor boat traffic accelerates the journey of nutrients to the lake. All lakes age and the lake can absorb a lot, but not unlimited human activity. The role of the town, the conservation commission and all land users, is to help manage the aging by understanding what is OK, what is too much and preventing excess through education, best practices and ordinances. The goal is that we and future generations enjoy the lake's economic, scenic and recreational values.



When we look at the Lake Winnipesaukee, we have to look beyond the surface water, to the land that sheds its waters into the lake. The lake is surrounded by hills, like a big bowl, with water at the bottom. Rainfall and wastewater within the watershed will gravitate towards the lake. So, while Lake Winnipesaukee itself is a bit over 44,000 acres, the water collection area is over 224,000 acres, or five times more land than lake. With an average yearly rainfall of 49 inches, about 300 billion gallons of water are added, each year, into the Winnipesaukee watershed. Some evaporates, replenishes aquifers or is stored by plants, but most of it finds its way to the lake, and out to sea via the Merrimack river. To help get a better handle on the health of our watershed, it is broken up into sub-watersheds. Each is analyzed separately for land use, nutrient loading and water quality. Moultonborough touches five sub-watersheds. Two of them, Center Harbor and Moultonborough Bay Inlet sub-watersheds are getting the most attention over the next few years. Next, let's look in detail at one of the five; the Moultonborough Inlet Sub-watershed.



The town's attention in 2014 is on analyzing the nutrient loading into the Moultonborough Bay Inlet (MBI) Sub-watershed. It is the subject of a grant that will result in a watershed management plan. The MBI is about 10% of the total Winnipesaukee watershed, extends into the town of Sandwich and includes portions of Red Hill and the Ossipee Mountains. It has about 1000 acres of Winnipesaukee surface water, and a huge 31:1 land to lake ratio, compared to 5:1 for the whole Winnipesaukee Watershed. There are 8 large ponds and over 12 tributaries. Over 17 billon gallons of water per year is flushed through the system yearly, replacing the water in the Winnipesaukee portion over 10 times per year. The large land to water ratio, combined with the heavy flush rate, means that the lake receives a lot of nutrients, and contributes an estimated 1500 pounds of phosphorus (a nutrient) to the rest of Lake Winnipesaukee, every year.

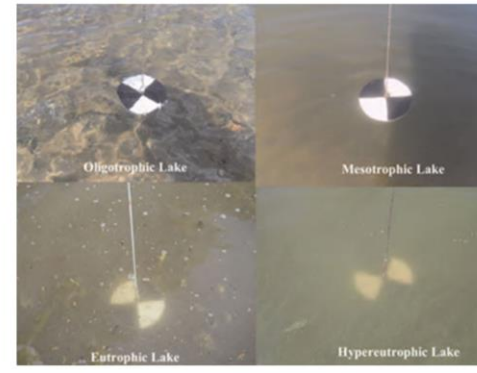


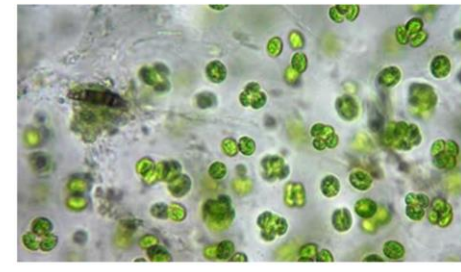
The conservation commission puts extra focus on the Moultonborough Bay Inlet (MBI) Subwatershed, because it has some unique and challenging characteristics. Water quality measurements indicate that it is no longer pristine, but is transitioning towards an enriched lake (more aged) faster than other areas of the lake. Some of this is because its large land to water ratio, driving a lot of nutrients from uphill wetlands after heavy rains. Other causes are likely due to development. According to NH's Department of Environmental Services (DES) reports, various locations within the MBI Sub-watershed have a history for impaired levels of phosphorus, chlorophyll-a, dissolved oxygen, e-coli and cyanobacteria. Non-native aquatic plants, such as milfoil, are also found in these waters. The area where Shannon Brook enters the lake (see figure 1) is on a 2007 impaired waters list, permitting state antidegradation rules to apply for large new developments within a one mile radius of the mouth of the brook. Through research, we will learn the health of the sub-watershed, trends and major contributors to degradation, then develop goals and a management plan to reach them.

What do the Measurements Mean?

Signs of impairment impacted by land use

- Phosphorus (parts per billion)
  - Plant food for algae
  - Biggest controllable factors are runoff, septics and fertilizer use
- Depth (meters of visibility)
  - Impacted by algae, sediment and turbidity and runoff
- Chlorophyll-a (micrograms per liter)
  - Microscopic algae (biomass)
  - Makes water look green
- Color (filtered chloroplantinate units)
  - Tannins, dissolved organic matter, iron
  - Impacted by runoff
  - Impacts perception of quality





The quality of lake water, while subjective, can be measured many ways. People judge it by how willing they are to use it, such as drinking, swimming and boating and determine property values by what and where they buy. We can also look at the dominate plant and animal life that flourish, which changes with the water environment. Phosphorus level is the most interesting metric to researchers, because phosphorus is the plant food that triggers algae growth, which degrades water quality. Phosphorus levels are also the easiest to control with watershed best management practices. As runoff is managed, septic systems maintained and fertilizers minimized, phosphorus levels in the lake go down. Visibility is also a great metric for public perception. Most people like clear water, where you can see the bottom in 15 feet or more. Microscopic algae is the biggest contributor to cloudy water, but heavy rain and boat traffic make it temporarily worse. Chlorophyll-a is measured by filtering the water samples and measuring how much biomass is left behind. Color is changed by dissolved organic matter, tannins and iron rust, and is another big factor in people's perception of water quality.

Clarity, Chlorophyll, Color and Phosphorus

Classification /Parameter	Oligotrophic (Pristine)	Mesotrophic (Transitional)	Eutrophic (Enriched)	MBI Data Min/Max/Avg (4 years of data)
Clarity (meters)	4+	2.5 – 4.0	Below 2.5	**2.2 – 6.8 (5.2)**
Chlorophyll (ug/L)	Below 3	3.0 – 5.0	5.0+	**1.0 -9.3 (3.2)**
Phosphorus (ppb)	Below 8	8-12	12+	**3.9-22 (10.3)**

Range (CPU)	Classification	MBI Values
0-10	Clear	
10-20	Slightly colored	Minimum 12.2
20-40	Light tea colored	**Average 32.2**
40-80	Tea colored	
80+	Highly tea colored	Maximum 96

115 measurements
2010-2013

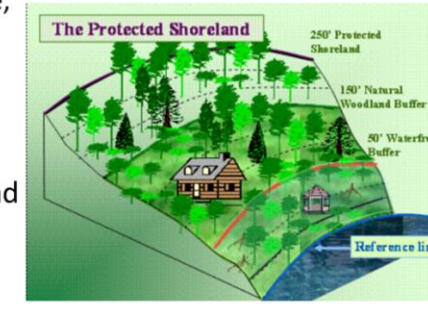
So, how are we doing in the Moultonborough Bay Inlet sub-watershed? Overall, the area is slightly impaired, but does not appear to be rapidly degrading. However, our recent four years and 115 data points is not enough to have confidence in a trend analysis, because weather factors can cause a lot of variation. The chart above shows the quality ranges for each metric, with the lake then designated as pristine, transitional or enriched. The MBI clarity averages a pristine 5.2 meters (about 17 feet), but individual readings range from an enriched 2.2M (7.2') to very clear 6.8M (22'). Chlorophyll-a averages at 3.2 micrograms per liter, classified as transitional. The phosphorus levels averages 10.3 parts per billion. This is also transitional, and above the state limit of 8 ppb for pristine lakes. Currently, Lake Winnipesaukee is treated as one water body, so the MBI sub-watershed is not designated as transitional, but in reality, it is. The upcoming load modeling exercise will tell us more about the capacity for the sub-watershed to handle additional phosphorus loading and identify the biggest load sources.

Moultonborough's Conservation Commission presented these recommendations to the town's planning board on January 22, 2014.

1. The Conservation Commission, along with NH Lakes Association and others, are working on a watershed management plan. This multi-year project will begin assessment and modeling in 2014. Having planning board collaboration during the analysis phase will help ensure practical and effective actions.
2. We already know that the MBI sub-watershed is sensitive to additional growth, land use close to the shoreline, disturbing wetlands and steep slopes and poor septic system maintenance. Adding watershed best management practices to the equation of property rights, planning ordinances and the town's master plan, should help ensure the variances, exceptions and new ordinances do not greatly degrade water quality.
3. The state's shoreline protection act, while controversial, is common ground from which to approve planning requests. The next step, is to increase compliance verification during and after construction, especially where maintenance is part of the plan.
4. Moultonborough has much land protected through conservation easements and current use taxing, but there are significant gaps. The Conservation Commission can help property owners understand options to voluntarily conserve the ecologic value of their property, and request help to identify willing land-owner opportunities.

Moultonborough Conservation Commission Water Quality Initiatives

- Watershed modeling and management project
  - Partners: NH Lakes, NHDES, US EPA and UNH
  - Follow-up from Center Harbor Bay project
  - Funding from Clean Water Act Section 319 Grant
  - Goal: identify restoration projects
- Layman Lakes Program – UNH
  - Five points are monitored monthly
  - Historical data available
- NH LoVoTECS Network - PSU
  - Tributary measurement of temperature, conductivity and stage
- Milfoil initiative
- DES Permit review
- Public and local government education
- Promote easements and current use land conservation



The Moultonborough Conservation Commission treats water quality as a high priority initiative. For the ongoing watershed management planning, its partners includes NH Lakes Association, Lakes Region Planning Commission, NH Department of Environmental Services, US Environmental Protection Agency, University of NH, Plymouth State University and others. Through UNH's Lay Lakes program, five spots within the MBI Sub-watershed are monitored monthly, and others on occasion. With Plymouth State University, Moultonborough is joining the NH LoVoTECS program, measuring temperature, conductivity and stage (depth) of four tributaries flowing into Winnipesaukee. The commission also works with the town's milfoil management program, reviews land use permits that require DES permits, and offers public and local government education and advice on conservation matters. Ongoing is the project to identify land with the most ecological value, so priorities can be set if voluntary easement, current use or purchase opportunities arise.

The picture above is from an outlook on Red Hill. Here, you can see how much more land than water there is, in the Moultonborough Inlet Subwatershed. The runoff flows from Garland Pond to Lees Pond to Lake Winnipesaukee. Much of the snow at the feet of the photographer, will eventually find its way down the hill, into Winnipesaukee and eventually down the Merrimack River into the Atlantic Ocean.

Moultonborough's citizens are active in supporting conservation efforts and clean water, as shown in the master plan survey and support for the milfoil budget. We need your help. Develop and follow your own watershed best management practices, where ever you can. The actions of 1000 people, each doing something to improve water quality, will be much more effective than studies, ordinances and renovation projects. If you are interested in joining in on the conservation efforts, there are many opportunities, both within Moultonborough, the lakes region and at the state level.

Links to Other Resources

- Winnipesaukee Gateway
  - winnipesaukeegateway.org/
  - Sub-watershed data and management plans
- NH DES Lakes Management & Protections Program
  - des.nh.gov/organization/divisions/water/wmb/lakes/
- UNH Stormwater Center
  - www.unh.edu/unhsc/
- NH Lakes Association
  - nhlakes.mylaketown.com/For-Property-Owners
  - Property Owner guidelines
- Lakes Region Planning Commission
  - http://www.lakesrpc.org/servicesresources.asp